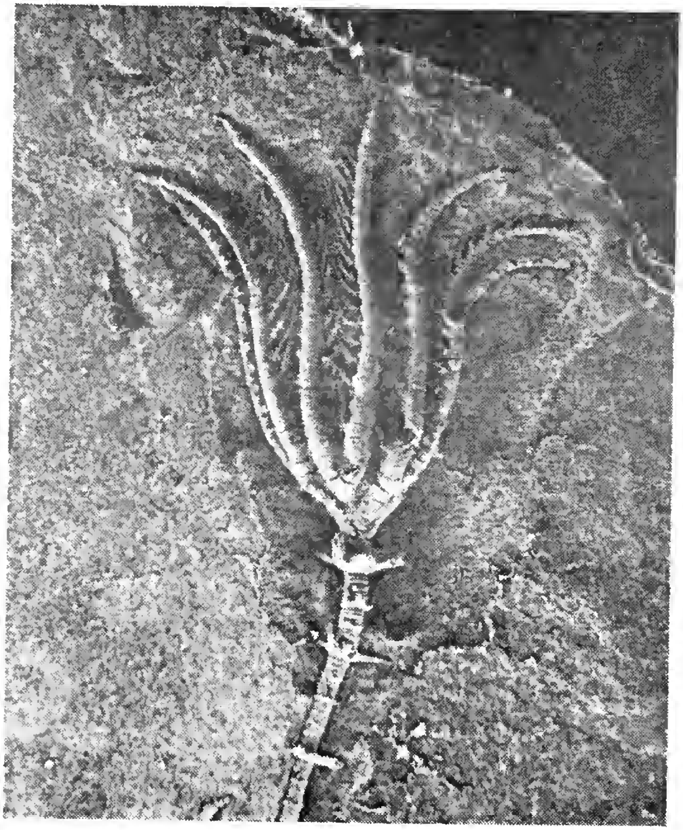
THE FOSSIL COLLECTOR

BULLETIN No 28 MAY 1989



Dimerocrinitidae gen. et sp. indet.
from Sugarloaf Reservoir, Victoria.

Published by
THE FOSSIL COLLECTORS ASSOCIATION OF AUSTRALASIA

THE FOSSIL COLLECTORS' ASSOCIATION OF AUSTRALASIA

SECRETARY
F.C. Holmes, 15 Kenbry Road, Heathmont, Victoria, 3135. (03) 7290447

REPRESENTATIVES
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NEW SOUTH WALES
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Ian Sobbe, M/S 422, Clifton, 4361. (076) 973372
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TASMANIA
John Fennell, R.S.D. 553, Allport St., Leith, 7315. (004) 240234 (work)
VICTORIA
Frank C. Holmes, 15 Kenbry Rd., Heathmont, 3135. (03) 7290447
WESTERN AUSTRALIA
Mrs. L. Schekkerman, 3 Pascoe St., Karrinyup, 6018. (09) 3416254

EDITORIAL

It appears the F.C.A.A., has again received some free publicity, this time in an overseas newsletter namely the PS - PRI News Published by the Paleontological Research Institution, Ithaca, New York. Some of you may recall that way back in 1980 when we were in the process of producing our first bulletin, details of our existence appeared in the West German Mineralien Magazine. While we have mainly relied on word of mouth to spread the news of our existence, we do receive an annual listing in "Australian Gold Gem & Treasure Magazine" and the "Mid American Paleontological Society " (MAPS) directory of overseas amateur and professional Paleontological Societies.

Last financial year F.C.A.A., subscriptions exceeded 220, however, this year renewals have been somewhat slower than usual and at the time of writing this editorial subscriptions are down to about 190, a figure which includes 13 new members. Nevertheless, we are financially sound, as our end of year balance sheet indicates, and are in the process of arranging a donation to the Western Australian Museum to assist in the collection of Tertiary plant fossils from south-west W.A. We are also looking for another museum or university funded project we can assist this year.

Those of you who have been watching "Saturday Night Clive" on ABCTV, will have noted that Sir David Attenborough is currently working on a series of T.V. programmes about famous fossil localities. At this stage we have no idea when they are likely to be completed and shown on T.V., but will endeavour to keep you informed.

When viewing "amateur" exhibition displays and competition entries

one occasionally questions details of the locality from which a particular fossil is reputed to have been found. Normally when such errors occur they can be put down to carelessness or failure to obtain and register information when collecting or swapping specimens. Over a period of time one becomes familiar with the type of material and matrix that originate from a particular collecting locality, to the extent that one at least queries unusual combinations of specimens locality and age.

It is therefore, very interesting to note that a fossil fraud is reported to have been perpetrated in India over the last 25 years, with fossil specimens having the characteristics of deposits from all over the world being passed off as coming from various localities in the Himalayas.

According to reports in the press, these allegations, if true, will force a rewriting of Himalayan Geology from Kashmir to Bhutan. It was stated that scientists often question a fellow worker's interpretation of data but rarely if ever, the primary data on which the interpretations are based. If you missed reading about it in the daily press, a summary of the alleged fraud is published in the "New Scientist" 29th April,1989.

Frank Holmes

FINANCES

Income and Expenditure for the Financial Year, 1st March,1988 to 28th February,1989 (previous year's income and expenditure shown in brackets).

INCOME		EXPENDITURE	
Subscriptions		Postage	690.94(491.41)
current	863.20(921.93)	Printing	521.34(336.87)
advance	619.09(717.67)	Photocopies,Photo's & photo screening	296.50(143.40)
Donations	36.50(7.11)	Stationery	184.60(9.38)
Advertising	33.00(-)	Sundries	136.85(86.10)
Bank interest	48.14(83.41)	Sub'n to FOGAMM	- (20.00)
Sale of Bulletins	93.35(138.20)	State Rep.expenses	47.90(10.50)
Sale of Car Stickers	- (3.00)	Donations	- (100.00)
		State/Fed.Tax	4.02(1.22)
		Refunds	- (12.00)
	$1,693.28(1,871.32)		$1,882.15(1,212.36)

Balance at 28th February,1989.

Brought forward from 1987/88		$1,844.31
Add income	1988/89	$1,693.28
		$3,537.59
Less expenditure	1988/89	$1,882.15
		$1,655.44 (1,844.31)

Cont...

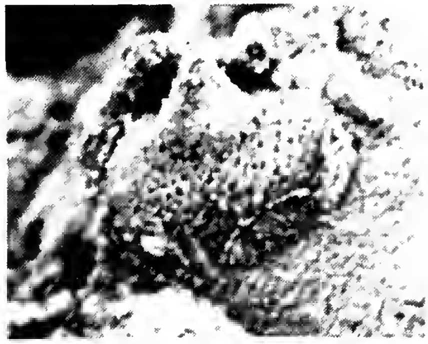
FINANCES (Cont.)

When the above figures are adjusted to include 1988/89 subscriptions paid in 1986/87 and 1987/88 ($842.07) and to exclude 1989/90, 1990/91 and 1991/92 subscriptions paid in advance ($619.09), income for the Financial Year 1988/89 exceeded expenditure by $34.11 compared with $361.89 for the previous (1987/88) Financial Year.

After deducting total advance subscriptions of $638.09 from balance in hand at 28th February,1989, we are left with a nett reserve of $1,017.35 at the beginning of the current Financial Year.

Assets valued at approximately $350 include stationery (envelopes), glue sticks, long arm staplers and back issues of the Bulletin.
At 28th February,1989 there were no liabilities.

PALAEONTOLOGICAL NOTE



In the article "Further Early Devonian Ostracodes from the Melbourne Trough" by Steve Eckardt, published in "The Fossil Collector", Bulletin No. 26, p.20-27, we omitted to illustrate *Sigynus* sp. This omission is herewith rectified, the specimen illustrated (right) being a left valve of *Sigynus* sp. x 28 from Middendorp's Quarry, Kinglake West, Victoria.

HAS ALBERTA GONE TO FAR?

Members will, no doubt, be interested in the problems that face amateur fossil collectors elsewhere in the world, in this case the effect of recent legislation on collecting in one of the Canadian provinces.

During September,1987, the Provincial Government of the Canadian Province of Alberta passed an amendment to their Historical Resources Act (Bill 11) which, according to a spokesperson for the Resource Management Programme of the Tyrrell Museum of Palaeontology at Drumheller, has clarified the position of amateurs in Alberta by defining ownership of fossil resources in the Province. Prior to this Bill, the legislation stated only that palaeontological resources were the property of the Province.

The 1987 amendment states, through the Disposition Regulations, that the Crown does not have any vested interest in fossils collected prior to July 5th,1978. As a means of defining which fossils the Province has jurisdiction over, a registration programme has been developed whereby persons with collections made prior to the above

date, can register them through the Tyrrell Museum. The registration of these collections, which has to be completed by December 31st, 1993, includes the requirement for photographs as well as written documentation of all specimens.

It is noted that Resource Management Programme staff will assist with the photography and documentation, however the collector is responsible for the purchase and development of film.

All fossils collected in Alberta since July 5th,1978, and all fossils still in or on the ground are owned by the Province.

Surface collecting is permitted on private land with the land owner's permission, however, the collector may only keep such finds as a custodian, since ownership of the fossils still resides with the Province. It is illegal to sell or take any fossil material out of the Province without an approved Disposition Certificate.

In the case of fossils "in the ground" a permit is required before excavation is allowed. Applications submitted on standard forms are processed through the Provincial Government's Resource Management Programme and reviewed by the Alberta Palaeontological Advisory Committee. Procedures outlined in the Historical Resources Act must be followed before any fossils collected can be retained. The Act does allow the Province to transfer to private parties the ownership of certain fossils considered to be abundant within the Province and thus have limited research and display value, these fossils are identified by a Control List established in 1987.

Needless to say the legislation has caused a degree of paranoia amongst collectors in Alberta some of whom believe that their collections will now be confiscated. Although, according to a government spokesperson, this is not the intention of the Act, the fact remains that the wording of the legislation would appear to allow such a course of action to be adopted quite indiscriminately in the future, should those in authority so desire.

While the reasons behind this type of legislation are usually to provide a tool to fight looting - the collection and exploitation of cultural and natural history objects for trophies and profit, rather than for preservation and knowledge; poor drafting and a lack of forethought only result in the alienation of the very people, in this case amateur palaeontologists and collectors, who could help the authorities police the situation.

A letter printed in the Alberta Palaeontological Society's Bulletin (December, 1988), points out that when a similar type of legislation, requiring registration of collections was introduced in Cont...

HAS ALBERTA GONE TO FAR? (Cont.)

another Province it not only failed to stop collecting but resulted in new finds and sites no longer being reported by amateurs. In addition artefacts being deemed to be crown property mysteriously migrating to other Provinces where they could be privately owned. In fact, the authorities found themselves in the dark watching helplessly as provincial material evaporated.

The current situation in Alberta is certainly food for thought for amateurs and professionals alike.

No one will deny it is necessary to stop the looting and exploitation of fossil sites for profit, but surely this could be achieved by less draconian measures than those now technically in force in this Canadian Province.

NOTE: This article has been based on information contained in the Alberta Palaeontological Society's Bulletin, Volume 3, No4, December 1988, and a leaflet published by the Tyrrell Museum of Palaeontology, Alberta Culture and Multiculturalism Department, both of which were given to the Editor by Les Adler of Calgary.

OMMATOCARCINUS CORIOENSIS (CRESSWELL), A FOSSIL CRAB FROM SOUTHEASTERN AUSTRALIA.

The following article is based primarily on information contained in a paper by R.J.F. Jenkins (1975) in the Memoirs of the National Museum of Victoria (Museum of Victoria).

In 1886, the "Victorian Naturalist" carried a brief description by the Rev. A.W. Cresswell, of a fossil crab found in nodules collected at Curlewis and North Shore near Geelong, Victoria.

This crab, named by Cresswell *Gonoplax corioensis* was later redescribed by Hall in 1905 and referred to the genus *Ommatocarcinus* White, fossil species of which occur in the Middle Eocene of Spain as well as the Neogene of Australia and New Zealand.

Jenkins (1975) also redescribed the species *O. corioensis* and analysed its systematic position relative to other described species of the genus, particularly the living species *O. macgillivrayi* White 1852 found on the east coast of Australia from Port Curtis, Queensland, south to the sea off Cronulla, near Sydney, N.S.W.

Ommatocarcinus corioensis (Cresswell,1886) is a member of the family Goneplacidae MacLeay,1838; Order Decopoda.

A reconstruction of the dorsal view of a male specimen in its life like attitude, as preserved in the sediment, is shown in Figure 1.

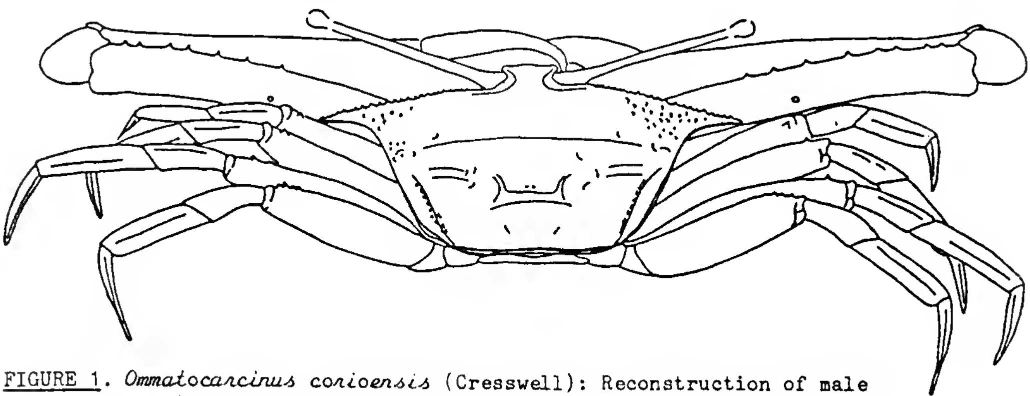


FIGURE 1. *Ommatocarcinus corioensis* (Cresswell): Reconstruction of male specimen in dorsal view showing ite life-like attitude preserved in the sediment, x 11/12. Figure from Jenkins (1975).

A complete diagnosis and description of the species, which is distinct for its elongate eyestalks and chelipeds, can be found on pages 35-40 of Jenkins' paper (see primary reference).

Since Hall's description numerous new specimens of *O. corioensis* have been found at widely distributed localities in southeastern Australia, including Tasmania and northern New South Wales (offshore).

Specimens studied are preserved in three different ways:
- (a) natural skeletal material in situ in sediments (e.g., Rutledge Marl Member, Port Campbell, Victoria);
- (b) skeletal material enclosed in phosphatic nodules which formed in the sediments (e.g.,Miocene at Port Campbell and Geelong, Pliocene near Hamilton, Victoria);
- (c) skeletal material enclosed in water-worn phosphatic nodules concentrated at the base of certain beds (e.g., Moorabool Viaduct Sands in the Geelong area, Victoria).

The preservation of the crabs in the phosphatic concretions (b) and the water-worn nodules (c) is identical; the latter being considered by Bowler (1963) to be remanié and representing water abraded concretions eroded from Miocene and possibly older sediments.

The following schedule and map (Figure 2) indicate the widespread distribution of the species as known in 1975 :-

MURRAY BASIN

- : Upper member of the Morgan Limestone near Morgan, South Australia (latest Lower Miocene).
- : Morgan Limestone near Waikerie,South Australia (late Lower to earliest Middle Miocene).

Cont...

OMMATOCARCINUS CORIOENSIS (CRESSWELL) (Cont.)

OTWAY BASIN

: Port Campbell Limestone in the vicinity of Port Campbell, Victoria (mid Middle Miocene to ? Upper Miocene) and similarly at Curdie and Timboon, Victoria.

: Base of Grange Burn Formation, west of Hamilton, Victoria (fragmentary remains in nodules, probably of Miocene age).

: Phosphatic concretions in the Grange Burn Formation, Forsyth's Bank near Hamilton, Victoria (Pliocene).

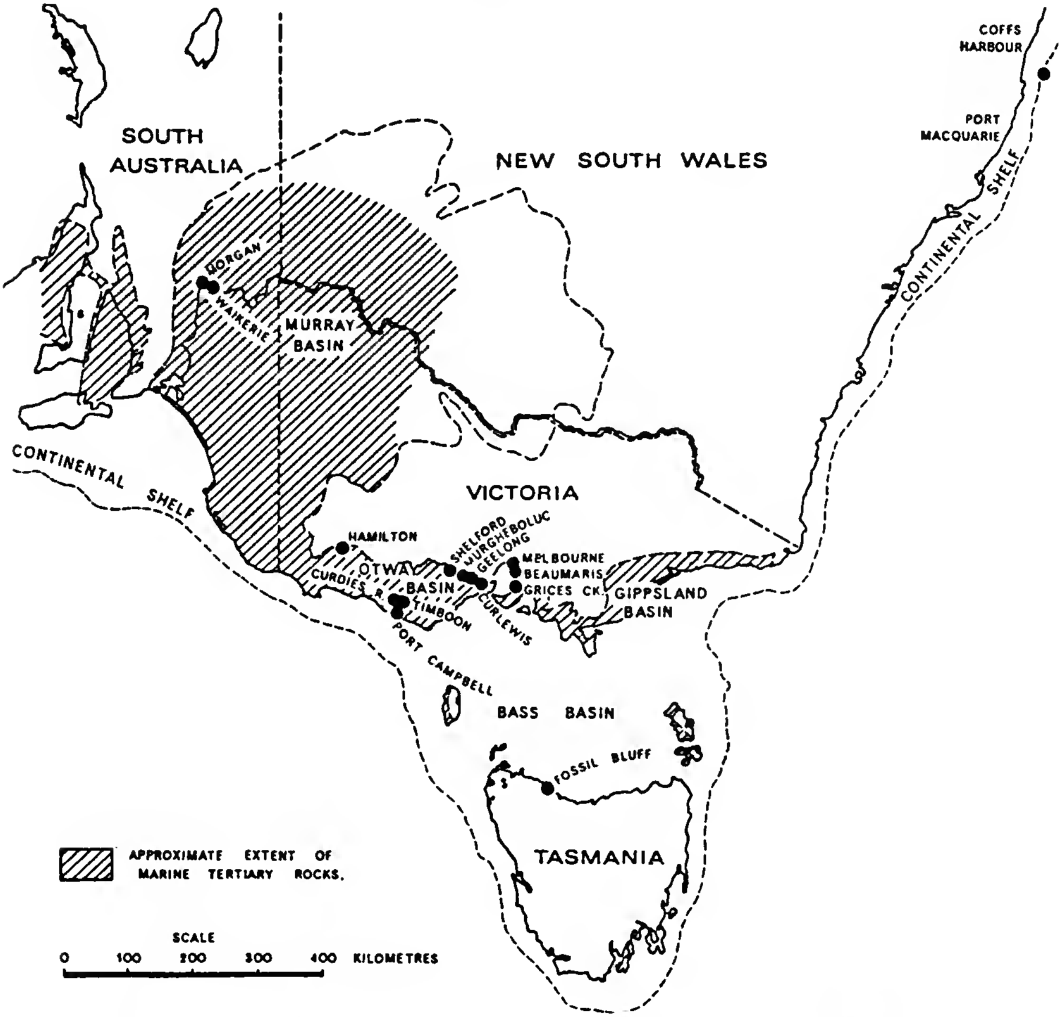


FIGURE 2. Locality map showing occurrences of fossil remains of *Ommatocarcinus corioensis* (Cresswell) in southeastern Australia •. Figure from Jenkins (1975).

- : Base of Moorabool Viaduct Sands near Shelford, Victoria, (remanié phosphatic nodules probably derived from the underlying early Middle Miocene, Fyansford Clay).
- : Phosphatic concretions in an interbed of the Fyansford Clay near Murgheboluc, Victoria (early Middle Miocene).
- : In bank of Barwon River at Murgheboluc, Victoria (early Middle Miocene).
- : ? Limestone bed in Fyansford Clay, North Shore, Geelong (Middle Miocene).
- : Remanié phosphatic nodules from the base of the Moorabool Viaduct Sands in the Geelong area, Victoria including Murgheboluc, Batesford, Fyansford, Cowies Creek, North Shore and Western Beach, Fenwick and the sea coast near Curlewis (all probably derived from underlying Miocene sediments).
- : Remanié phosphatic nodules from the base of the Black Rock Sandstone at South Yarra and Beaumaris, in the Melbourne area (possibly Late Miocene in situ or from underlying Lower to Middle Miocene strata).
- : Pair of chelae (pincers) from Balcombe Clay, Grices Creek, near Mornington, Victoria (Middle Miocene).

BASS BASIN

- : Fossil Bluff Sandstone, Fossil Bluff near Wynyard, Tasmania (Lower Miocene).

CONTINENTAL SLOPE OFF NEW SOUTH WALES

- : Fragmentary remains in nodules recovered from the upper part of the continental slope off Coffs Harbour, northern New South Wales.

Cont...

FIGURE 3. *Ommatocarcinus corioensis* (Cresswell) x 1.25 from Port Campbell, Victoria.

OMMATOCARCINUS CORIOENSIS (CRESSWELL) (Cont.)

The most abundant occurrences of *O. corioensis* known, is in the Port Campbell Limestone, a transgressive, neritic (continental shelf, marine unit (Glenie, 1971).

The crab's association with fine grained sediments almost certainly reflects its burrowing habits.

Some of these fossil specimens are remarkably complete and well preserved, in particular those from the Rutledge Marl Member of the above Limestone formation.

In addition the echinoids *Brissopsis tatei* Hall, 1907; *Lovenia woodsi* (Etheridge, 1875); *Schizaster (Schizaster) sphenoides* Hall, 1907; and *Spatagobrissus laubei* (Duncan,1877), although not abundant, are found associated with the crab in the Port Campbell area.

However, as most of the sites in this area now occur in the Port Campbell National Park (proclaimed 1964 and extended 1981), permission to collect would have to be obtained from the National Parks and Wildlife Division of the Department of Conservation, Forests and Lands, Victoria.

PRIMARY REFERENCE

Jenkins, R.J.F., 1975. The Fossil Crab *Ommatocarcinus corioensis* (Cresswell) and a review of related Australasian species. Mem. natn.Mus.,Vict. 36: 33-62, pls.4-8.

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ERRATUM - BULLETIN No. 27

Page 32, "Palaeogeographic Atlas of Australia". The scale of the maps quoted in paragraph 2, should read 1:10,000,000 not 1:10,000.

(If the latter scale was correct, a truck would be needed to carry the number of maps in each set. Ed.)

THE BIG STEP IN VERTEBRATE EVOLUTION: DID THE FIRST FOUR-LEGGED ANIMALS EVOLVE IN AUSTRALIA?

by Dr. John Long, Research Fellow, Geology Department,
The University of Tasmania, Hobart, Tasmania.

Buried in the greenish shales and sandstones of the Transantarctic Mountains could lie clues to one of evolution's greatest mysteries - where did the first four-legged animals (tetrapods) originate? The group most likely to have given rise to tetrapods were the lobe-finned fishes or crossopterygians, and recent discoveries from Australia and Antarctica indicate that during the Devonian period, some 360-410 million years ago, the continent known as "East Gondwana" (Australia and Antarctica joined - Fig.1) was a centre of rapid evolution and diversification of these fishes. Today only one of these fishes survives, the coelacanth, first caught off the coast of Madagascar in 1938. Most of our knowledge of the group comes from fossils.

For over a century the traditional view of tetrapod origins was that a certain extinct group of lobe-finned fishes, the osteolepiforms (Fig.2), evolved into tetrapods, probably in the continent known as "Euramerica" which comprised western Europe, Greenland, Britain and North America (Young,1981). The evidence was simple: the earliest fossil amphibians, of Late Devonian age (365 million years ago), had been discovered in the 1930's from East Greenland,

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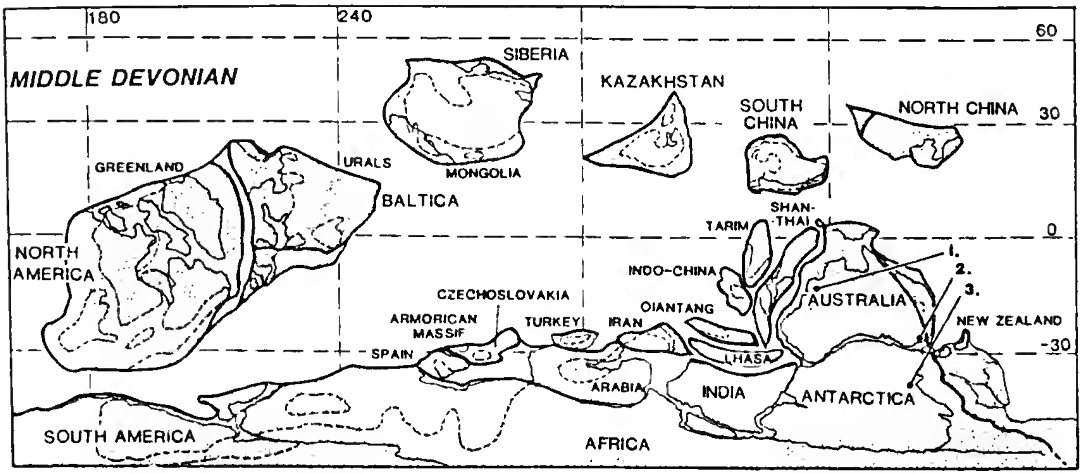

FIGURE 1. Global reconstruction for Middle Devonian times (375-390 million years ago), when Australia and Antarctica were joined to form the "East Gondwana" Province, the antipodes to "Euramerica" (western Europe and U.S.S.R., Greenland, Britain and North America). Note close relationship of Australia/Antarctica fossil sites: 1. Gogo (Western Australia), 2. Mansfield, Mt.Howitt (Victoria), 3. South Victoria Land (Antarctica). Reconstruction after Burrett, Long & Stait, in press.

THE BIG STEP IN VERTEBRATE EVOLUTION (Cont.)

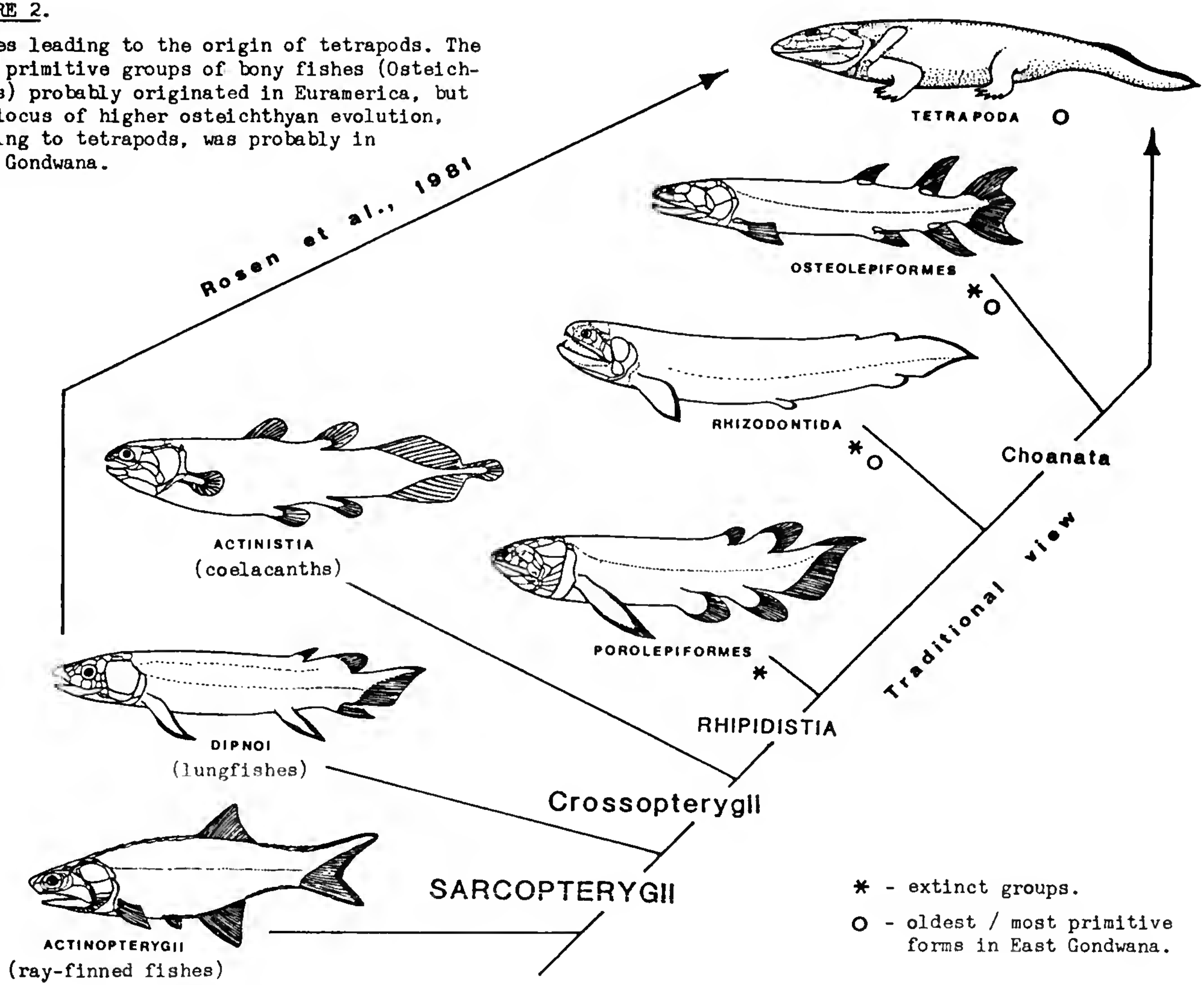

FIGURE 2.

Stages leading to the origin of tetrapods. The most primitive groups of bony fishes (Osteichthyes) probably originated in Euramerica, but the locus of higher osteichthyan evolution, leading to tetrapods, was probably in East Gondwana.

and most species of fossil osteolepiform fishes, their reputed ancestors, also came from the ancient supercontinent. However, it is only in the last decade or so that Australian scientists have come into the picture. The many new finds of the osteolepiform fishes from eastern Victoria (Mt. Howitt, Long 1985a,1987a; Mansfield, Long 1989), New South Wales (Long, 1985b; Young and Gorter, 1981), central Queensland, and from Gogo in the rugged Kimberley district of Western Australia (Long 1985c,1987b, 1988a), have put Australia in the fore front of research on early osteichthyan evolution. Not only are some of these finds extremely well-preserved (e.g.,Gogo, W.A.), looking like the fishes died only days ago (rather than 370 million years ago), but they are unusual in not conforming to the expected skeletal plan that typifies so many species from Scotland, America and Baltic Russia. In fact they are more than just new species and genera, as some constitute completely new higher taxonomic groupings (families,orders). Today systematic description of this new material continues and it is becoming clear that many of the Australian and Antarctic species are more primitive than osteolepiforms known from "Euramerica" (Fig.3). This, coupled with the recent discovery of the world's oldest possible tetrapod trackways, from the Grampians in eastern Victoria, by Dr. Anne Warren of Latrobe University (Warren et al, 1987), points to a possible origin of the first tetrapods in East Gondwana. Despite an almost complete absence of Devonian amphibian fossils in Australia - we have one fossil jawbone (Campbell and Bell,1977), there are vast areas of exposed rocks of the right age and sedimentary environment for finding the 'missing links', so it is probably only a matter of time before such discoveries are made.

The evolution of fishes to tetrapods was the biggest step in vertebrate evolution, involving a whole range of physiological and functional adaptations for leaving the water and invading the land. By comparison, the evolution of amphibians to reptiles, and from reptiles to mammals and birds is rather simple. Current opinion is that osteolepiform fishes, already possessing powerful limb skeletons with bones homologous to our own humerus, ulna and radius in the arms, and femur, tibia and fibula in the legs could push themselves out of the water to walk between tide pools or lagoons to reach new food sources.

Periodic invasion from shallow marine habitats into estuaries and rivers may have resulted in the discovery of quiet places to breed and gradually enabled the fishes to acquire physiological adaptations to freshwater. Aside from the convincing similarities in the limb skeletons, the osteolepiform fishes possess remarkably similar skull roof bone patterns to those of early amphibians, similar types of vertebrae, a similar cheek bone pattern of seven bones, and teeth with complex infolded dentine and enamel. Cont...

THE BIG STEP IN VERTEBRATE EVOLUTION (Cont.)

However, one school of thought, led by the late Donn Rosen of the American Museum of Natural History and his colleagues at the British Museum (Natural History), challenges the traditional view by suggesting that the lungfishes, another primitive fish group, may be closer anatomically to amphibians (Rosen et al, 1981). Lungfishes survive today in three countries, including Australia. Because of this, their internal anatomy is well known and can be directly compared with that of living amphibians. This is in contrast to the extinct osteolepiforms that are known only from skeletal remains. By their study of living lungfishes and amphibians, with lesser weight given to fossil evidence, Rosen et al., alleged that there are many similarities between lungfishes and amphibians, and that these point to a close phylogenetic relationship. They proposed that the ability to breathe air was a specialisation which evolved in lungfishes and amphibians, and that the fossil remains of osteolepiform fishes had been somewhat misinterpreted.

This radical new viewpoint, published in 1981, was partially incited by the rich finds of fish fossils from Gogo, in the Kimberley district of Western Australia. The beautiful three-dimensional lungfish skulls from this site can be freed from their limestone casings by immersion in weak acetic acid followed by impregnation of the exposed bone with plastic glues (Long,1988b). The results are outstanding, uncrushed specimens in which the lower jaws can even open and close! The Gogo lungfishes appeared to show that internal palatal nostrils (choanae) were present on primitive lungfishes, when such features were previously thought to exist only in amphibians and osteolepiform fishes. The new hypothesis, that lungfish may have given rise to tetrapods, called for a critical reappraisal of the evidence for the traditional osteolepiform tetrapod relationship. One important character, the internal nostrils, was re-interpreted by Rosen et al., as being non-functional in osteolepiforms as they suggested that the large fangs of the lower jaw inserted into the openings in the palate, thus blocking the nostril. However, their evidence for this was based largely on rescaled drawings of the palate and lower jaw of osteolepiform fishes and not actual specimens showing how the mouth closed.

In late 1986 a field party led by the author discovered the first complete three-dimensional skull of an osteolepiform fish from Gogo, (Fig.4). This specimen clearly demonstrates that the lower jaw fangs did not block the palatal nostril but inserted well away from these openings (Long, 1987b). New material of lungfishes from Gogo has also provided evidence that lungfishes probably evolved the ability to breathe air independently of amphibians, thus ruling them out as likely candidates to have given rise to tetrapods. The new

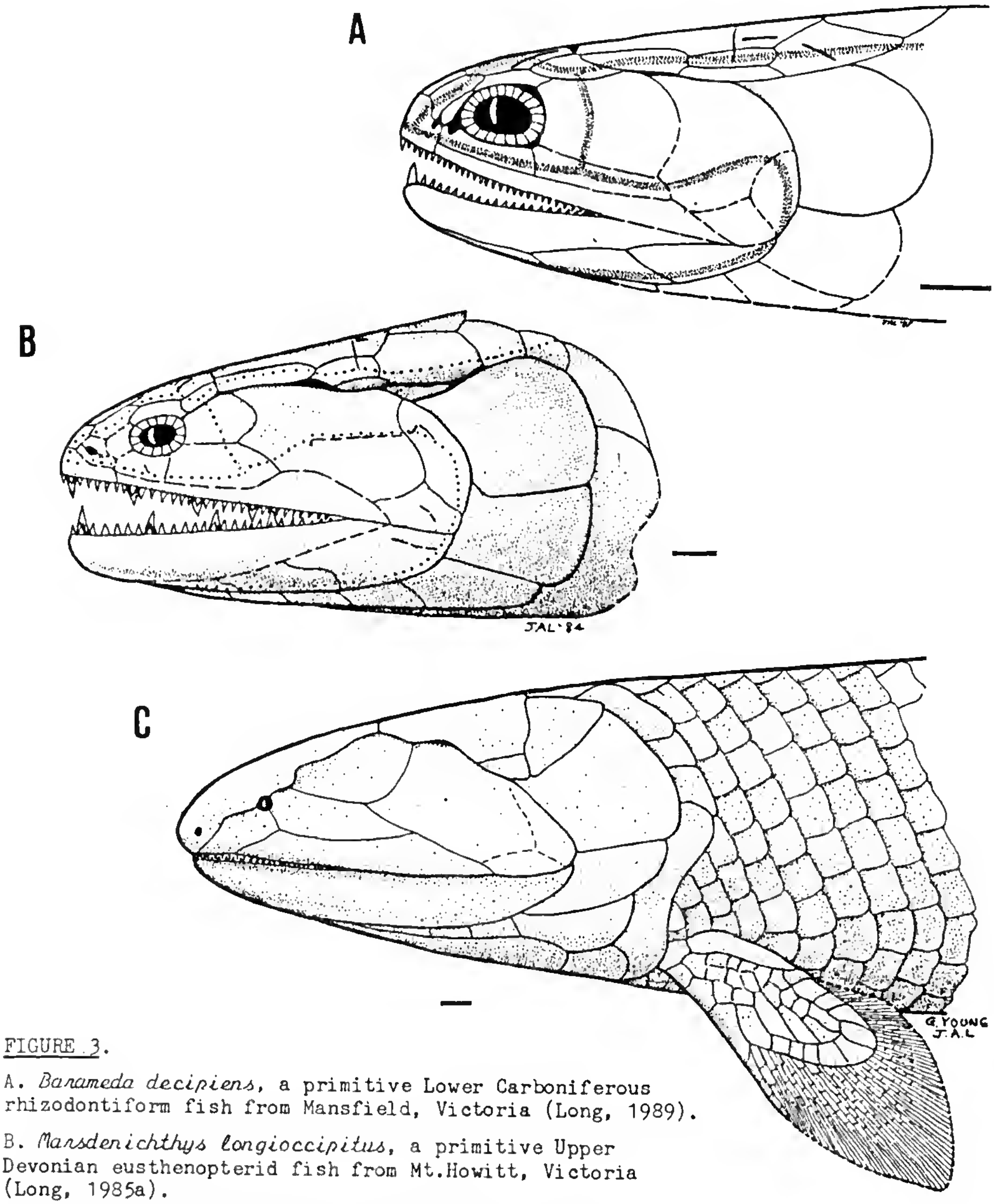

FIGURE 3.

A. *Barameda decipiens*, a primitive Lower Carboniferous rhizodontiform fish from Mansfield, Victoria (Long, 1989).

B. *Marsdenichthys longioccipitus*, a primitive Upper Devonian eusthenopterid fish from Mt.Howitt, Victoria (Long, 1985a).

C. New genus from an endemic Middle Devonian crossopterygian group from Mt.Crean, South Victoria Land, Antarctica (Young, Long & Ritchie, in press).

New species of osteolepiform fishes, such as these from Australia and Antarctica, suggest that much of higher bony fish evolution could have taken place in Australia, resulting in the rise of the first amphibians. (Scale bars = 1 cm.)

THE BIG STEP IN VERTEBRATE EVOLUTION (Cont.)

data comes from Prof.Ken Campbell and Dr. Richard Barwick at the Australian National University. Their detailed studies of Gogo lungfish skulls have revealed that the gill arch bones supported a full compliment of functional gill arches, a normal condition for water respiring fishes. In modern lungfishes which gulp air periodically, only the first two or three gill arches are functional. Furthermore, geological study of the Gogo sites indicate that the fishes would have had to rise up from the seafloor, over 100 metres deep, to gulp air - an unlikely habit given that they are adapted for feeding on the seafloor and their body and fin shapes are not of the design for regular rapid rises to the surface.

Australia and Asia are amongst the few frontier countries left for palaeontological research. Unlike Europe, North America and Britain where most of the principal fossil localities have been heavily collected and the material studied, new finds of rich fossil deposits

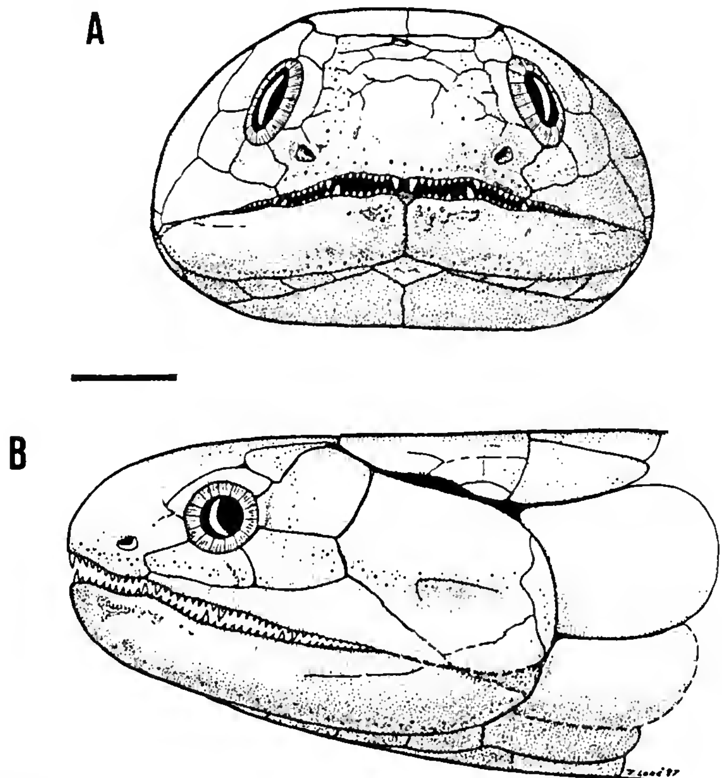

FIGURE 4.

The reconstructed head of *Gogonasus andrewsi* (Long, 1985c), based on new material discovered in 1986. (Scale bar = 1 cm.)

are not uncommon in this country. As we have few vertebrate palaeontologists in permanent employment to carry out research on these discoveries, the net result is that the scientists are flat out trying to keep up with the incoming voluminous collections of new and important finds. Work on early fossil fishes in Australia is, however, not just directed at solving evolutionary problems. Fish remains are also useful for the correlation and age dating of rock strata. Such work is of value to petroleum companies in drilling programs, and already in the U.S.A., fish palaeontologists are employed to research underground correlation of potential oil reservoir rocks by using microscopic remains of fishes recognised from drill core samples. Increasing knowledge from new fossil fish discoveries also enables predictions to be made about global base maps for certain periods of geological time. Dr.Gavin Young (1986), of the Bureau of Mineral Resources has used distribution patterns of fossil fishes to test past continental positions constructed from other data sets (e.g., palaeomagnetic and palaeolithologic information).

Such high rates of new discoveries in Australia have major relevance to biogeographic theories: by finding more primitive species of fishes in older rocks here, as compared with Euramerican sites, it seems likely that Australia was the "centre of origin and diversification" for many groups of early vertebrates. However, before the case for an East Gondwana origin for amphibians can be fully supported we need to find fossil remains of advanced osteolepiforms that share highly specialised, unique features with amphibians. Such groups, like the panderichthyids, are currently known only from Euramerica, but the search in Australia and Antarctica has only begun, and each year fieldwork is yielding more new species. Given time, and continued funding for palaeontological research, one of evolution's greatest steps, the transition from fish to amphibian, might be better understood. If it did take place in Australia or Antarctica this would indicate that many more exciting and scientifically valuable finds could be on the horizon.

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HISTORY OF AUSTRALIAN AVIFAUNA (Part 2)

This is the second part of a two part article on the fossil record of Australisn birds. It has been adapted from a paper by Drs. Pat V. Rich and Robert F. Baird that appeared in Current Ornithology Vol. 4, 1986. The F.C.A.A. wishes to thank the authors for permission to use this material.

BIASES OF THE AVIAN FOSSIL RECORD OF AUSTRALIA

The Quaternary Record

Australian caves present a unique variety of physical and biological forces having the ability to accumulate and deposit bone within a relatively stable chemical and physical environment. Among the physical forces are lacustrine and fluviatile depositional environments and deposits of pitfall origin. A lacustrine environment has been implicated in the accumulation of birds within Green Waterhole where the specimens exhibit good preservation but are never found articulated. The disarticulation is thought to have occurred through gravitational creep down a talus cone. Faunal analysis has also implicated a lacustrine environment, due to the high percentage of flocking birds, which today are known to drown frequently in stock watering tanks, which are essentially simulated lacustrine conditions. Sheetwash and sorting due to fluvial action have been proposed for the distribution of fossil vertebrates in both Victoria Fossil Cave and

McEachern's Cave. Cave deposits of pitfall origin can be identified through composition of the avifauna, condition of the bone, and the numbers of all skeletal elements in the deposit. The composition of the avifauna will clearly be skewed toward flightless birds or those with little ability for vertical flight. In most cases bones are well-preserved, with damage incurred either through the fall into the cave or through subsequent chemical effects. The proportions of skeletal elements should be as they would be in life. Caves with deposits considered to be primarily pitfall in origin are Colliver's Cave and Mammoth Cave.

There are several factors that need to be included in the discussion of the taphonomy of cave deposits. First is collecting bias - unless the deposit is collected en masse or at least seived through fine-meshed screens, the resulting material will not include elements that are not readily visible. Hence, any taphonomic analysis based on incomplete collecting techniques will yield inadequate results unless this bias is understood.

Another bias that may mask the characteristics of the primary accumulator is that those species of birds frequenting caves for roosting, nesting or foraging, such as falcons, barn owls, owlet nightjars, swifts and swallows, would also be incorporated in the deposit and, therefore, should be excluded in the analysis of taphonomic accumulators.

Accumulation of vertebrate material in caves is not necessarily the result of physical forces, but is frequently due to the action of predators using caves as dens, roosts, and nesting areas. Australia is particularly fortunate to have a wide variety of vertebrate predators using caves. These include mammals (e.g., *Dasyurus* spp., *Sarcophilus harrisii*, *Homo sapiens*, and *Macroderma gigas*) and birds (e.g., *Falco cenchroides*, *Tyto alba*, *and T.novaehollandiae*). By analysing the condition of the skeletal material and the faunal composition of the deposit, a primary accumulator for each deposit can often be determined. Frequently, more than one accumulator may have contributed to the deposit, and unless the material can be separated through diagnostic characteristics of breakage, the primary accumulator of the deposit may be obscured through mixing or reworking by scavengers. Condition of the bone is not only due to the action of mastication but also to chemical "weathering" from the pH of the stomach acid of the carnivore involved. Nevertheless, because the biases of the modern counterparts can be studied, the determination of the primary accumulator can be used in the discussion of paleoenvironments.

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HISTORY OF AUSTRALIAN AVIFAUNA (Cont.

The Faunal Record - The Pre-Quaternary

The fossil record of birds in pre-Quaternary sediments provides information on past environments, biogeography, and evolutionary patterns. Inferences from this record, however, are at a relatively early stage at present because the record has significant gaps both temporally and geographically at any one time. The most significant is the lack of a Cretaceous and Paleogene record spanning the time between about 100 and 22 million years. This is particularly significant because it was a time when birds were differentiating and also a time, especially in the Cretaceous and early Paleogene, when Australia was connected to Antarctica and tenuously to South America, with the greatest possibilities for intercontinental faunal exchange.

Considering the record at hand, several groups are known from a number of localities in sediments that range in age from possible Early Miocene to Recent and include Dromornithidae (extinct flightless birds), Dromaiinae (emus), Spheniscidae (penguins), Phalacrocoracidae (cormorants), Pelecanidae (pelicans), Phoenicopteridae (flamingoes), Accipitridae (hawks, eagles), Anatidae (ducks geese and swans), Rallidae (rails), Charadriiformes (wading birds) especially the Burhinidae (stone curlews), and the Passeriformes (song birds). Of these groups, although the record is long and from several localities, specimens are few for the Spheniscidae, Phalacrocoracidae, Pelecanidae, Accipitridae and Rallidae, so few that evolutionary patterns are unlikely to emerge unless further material is collected. Of the families known to have long ranges only the Dromornithidae the Dromaiinae and the Phoenicopteridae have been adequately studied to allow speculation on implications.

Other groups such as the Anatidae have marked potential when studied because of their abundance and lengthy time range. Two other groups with shorter time ranges also have importance, the Burhinidae and the Palaelodidae, (flamingo like birds). Each of these groups will be briefly discussed in turn.

The Dromornithidae

The dromornithids, or mihirungs, represent a group endemic to Australia that are now extinct. The group survived from at least the Miocene until 26,000 years ago, perhaps later. They were large flightless ground dwelling birds whose relationships are still not understood, although they have previously been allied with ratites (living flightless birds) and galliform (game) birds. In fact, they appear to be so highly derived in skull structure that their relationships may remain obscure until older, more primitive forms are

located. The group appears to have been herbivorous because they form the bulk of the biomass (up to 60-70%) at Bullock Creek and a large part of Alcoota, both Late Miocene sites. In these sites, forms known to have been carnivorous, such as the marsupial thylacoleonids, are extremely rare (as expected from modern examples).

Dromornithids are known mainly from bony remains, but also have left tracks, gizzard stones and eggshells. One eggshell fragment associated with this group from sediments thought to be Miocene in age from near Marree, South Australia, has a thickness of 4 mm and probably represents an egg with a minimum width of 126 mm.

A total of five genera and eight species are known, with the greatest diversity occurring early in the history of the group. This suggests that the family has a much longer history stretching back into the Paleogene that is yet to be discovered.

Species of dromornithids have restricted time ranges and so can be used biostratigraphically. *Genyornis* is restricted to the Pleistocene, whereas all other genera except *Dromornis* are restricted to the Miocene. *Dromornis* extends from the Miocene into the Pliocene. *Ilbandornis* and *Bullockornis* occur only in the Late Miocene, whereas *Barawertornis* is probably restricted to the Early Miocene.

The Dromaiinae

The fossil record of emus begins in the Miocene, most likely because of a record bias. Two extinct species occur in pre-Quaternary sediments, but they are based on limited material. A new species of *Dromaius* from medial Miocene sediments at Lake Ngapakaldi, South Australia, is known from an incomplete but associated left leg. This species is smaller than the living emu, *D.novaehollandiae*, but more importantly differs from the modern species in proportion of the digits. The shortening of the inner and outer digits in the modern emu appears correlated with cursorial efficiency, and by this gauge the medial Miocene form does not seem so highly adapted to that life style, having more the proportions of the forest dwelling cassowary, although still clearly an emu in other morphological features.

Dromaius ocypus is a second pre-Quaternary emu species that is based on a partial limb. The bones may not belong to a single individual but they all come from the same locality (Lawson Quarry), at Lake Palankarinna, South Australia, and are probably medial to Late Pliocene. As with *Dromaius* n.sp., from Lake Ngapakaldi, this latter species is also smaller than the living emu.

Pleistocene emu fossils from the mainland of Australia are much more plentiful than Tertiary forms, as are those of the dwarf emus on Kangaroo Island (*D. baudinianus*) and King Island (*D.ater*). The

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HISTORY OF AUSTRALIAN AVIFAUNA (Cont.)

mainland fossils all seem to belong to *D. novaehollandiae*, despite a variety of specific names that have been applied to these fossils. The identity of Tasmanian Pleistocene emu fossils remains unresolved.

In summary, the pre-Quaternary record of emus is one of forms clearly belonging within the Dromaiinae, based on detailed morphology of the articular ends of hind limb bones, but ones that are smaller and have proportions intermediate between the closed forest dwelling cassowaries and the more open-country emus. Such trends correlate nicely with changing vegetation patterns reconstructed primarily from palynological data. These reflect substantially forested conditions, at least along the watercourses in the Lake Eyre Subbasin during the Miocene that became progressively more open through the Pliocene reaching a peak of aridity in the Pleistocene.

The Phoenicopteridae and the Palaelodidae

Flamingoes are not known to occur in Australia today, but are known throughout most of the fossil record of birds on this continent. *Phoenicopterus novaehollandiae* and *Phoeniconotius eyrensis* are both known from medial Miocene at Lake Palankarinna (Ngapakaldi Fauna), South Australia. Both *P. navaehollandiae* and *P. eyrensis* were about the size of the living Greater Flamingo (*P. ruber*).

If habits of flamingoes were within the range of tolerance that they are today, at minimum there must have been reasonably permanent lakes in the Lake Palankarinna area, lakes reliable enough to allow feeding and breeding of these specialised colonial birds.

Later desiccation of central Australia led to the end of such conditions on a year-to-year basis, and birds such as the flamingoes, which were unable to cope with the droughts and ephemeral lacustrine conditions, were to become extinct. But they did survive for quite some time. Pliocene sediments at Lake Kanunka in the Lake Eyre Subbasin contain three species of flamingoes that most likely coexisted, representing three distinct sizes of birds; one the size of the living Lesser Flamingo (*Phoeniconaias minor*), but certainly distinct from it; another within the size range of the living *P. ruber* and possibly conspecific with it; and a third species which may have been distinct from *P. ruber*.

Flamingoes are also known in Pleistocene sediments, but dating these occurrences is difficult or impossible at present, consequently just when this family became extinct on a continent-wide scale is still undetermined.

Another group thought to be closely related to the flamingoes,

the Palaelodidae, also occurs alongside flamingoes in the medial Miocene sediments at Lake Palankarinna. The importance of this group is both biostratigraphic and paleogeographic as Palaelodids are known to occur in the Miocene and Pliocene of Europe and the Pliocene of western North America.

The Burhinidae

The Burhinidae (stone curlews) known from several localities of Miocene age in both the Lake Eyre and Lake Tarkarooloo Subbasins have not yet been thoroughly studied, but offer promise for understanding evolutionary patterns within this group. One collection of fossils from the Early to medial Miocene sediments of Lake

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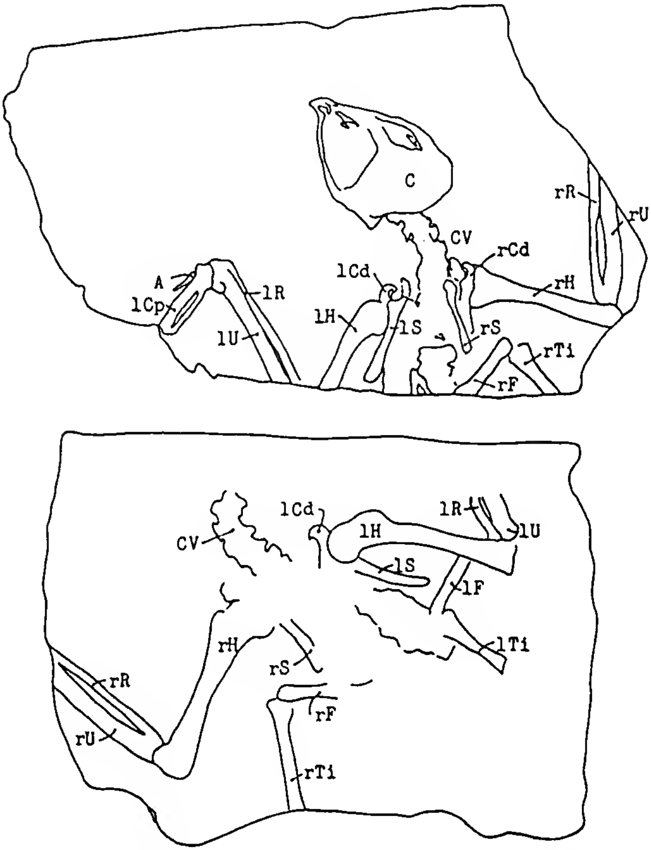

FIGURE 5.

Quipollornis koniberi, a nearly complete skeleton of a Miocene aged aegothelid (owlet nightjar) from the Warrumbungle Mountains of eastern New South Wales. Abbreviations: l, left; r, right; A, alula; C, cranium; CV, cervical vertebrae; Cd, coracoid; Cp, carpometacarpus; F, femur; H, humerus; R, radius; S, scapula; Ti, tibiotarsus; U, ulna.
Drawing of part and counterpart from "The Fossil Vertebrate Record of A'asia"

HISTORY OF AUSTRALIAN AVIFAUNA (Cont.)

Pinpa in the Tarkarooloo Subbasin of northeastern South Australia contains over 100 bones of one species of burhinid, including cranial material. This material is as old as, or perhaps slightly younger than *Burhinus lucorum* from the Early Miocene of central North America. The Australian fossils, although disarticulated, come from a very limited area at the same stratigraphic level and probably represent one species (perhaps even a natural population). Most elements of the skeleton are represented, and these will offer the oldest nearly complete view of burhinid structure.

Burhinids, like the flamingoes, are known from many of the central Australian Miocene locales and thus are of biostratigraphic and biogeographic value.

The Aegothelidae

Only one pre-Quaternary aegothelid is known in Australia, *Quipollornis koniberi*, (Fig.5) from mid-Miocene lacustrine rocks in the Warrumbungle Mountains, New South Wales, known to be contemporaneous or slightly older than 13.5 - 17 million years old. *Quipollornis* is significant because it is one of the few articulated, nearly complete bird fossils known in rocks older than a few thousand years in Australia. It clearly belongs in the family Aegothelidae. The main differences between extant aegothelids and *Quipollornis* are in the limb proportions. These proportions attest to a more aerial insectivorous lifestyle rather than the more terrestrial habits of aegothelids today.

The Faunal Record - The Quaternary Period

The amount of precipitation in Australia interpolated from pollen assemblages was close to that of the present day from the last interglacial to approximately 80,000 years BP, at which time there was a sharp decrease which continued to about 40,000 years BP. A sharp change and reduction in precipitation at this point and again at about 26,000 years BP resulted in considerable changes to the type and extent of vegetation throughout the continent, in particular the loss of rainforest in the north. At approximately 10,000 years BP, the precipitation increased to above normal before finally decreasing to near present day level.

The changes from wetter- to drier-adapted flora are reflected in the avifauna for this period. Although there are no known continuous fossiliferous sedimentary sequences that cross this boundary, there are faunas indicating large changes in the vegetation. At Pyramid Cave, one of the oldest deposits containing birds in the southeastern region, the avifauna includes at least two genera

Orthonyx (logrunners), and *Athrichornis* (scrub birds) that are currently allied to rainforest conditions in eastern Australia, although there is some argument that the former has always been restricted to rainforest. In addition one extant species of *Atrichornis (A. clamosus)* currently lives in a habitat which is moist but certainly not rainforest.

On the other hand the avifauna in Green Waterhole Cave has no real indicators of habitat although certain elements point to a dry sclerophyl habitat. It is, however, different from all other faunas because of the presence of species unique to the deposit, namely *Orthonyx hypsilophus* and *Centropus collosus*(a member of the cuckoo family).

One hundred kilometers north of the Green Waterhole area are cave deposits containing extinct fauna of a different kind (e.g., *Progura*, a mound builder which is associated with dates between 30,000 and 40,000 years BP; therefore, the fauna of Green Waterhole indicates that a change in habitat may have occurred either temporally or geographically, but whether the change was toward a more pluvial (rainy) or more arid period is yet unclear.

Throughout the 30,000 to 40,000 Years BP period there were also very large accipitrids (hawks and eagles) present, the demise of which is associated with the loss of the large mammalian species sometime before the height of the last glaciation. Because of their large size, they probably acted as scavengers, holding similar ecological niches as vultures.

Little can be interpreted of the rest of the deposits that have avifaunal material associated with radiocarbon dates between 30,000 and 40,000 years BP. In general, the bird species represented rarely differ from those of today, except in the case of *Progura* and some of the as yet undescribed extinct fauna. The material from Devil's Lair includes both *Atrichornis clamosus* and *Dasyornis longirostris* (a bristle bird) which indicate that both heathland and wetlands with dense vegetation were present, similar to today. Madura Cave at this period of time had a species of *Amytornis* (a grass wren), a genus not known to have occurred on the Bunda Plateau since European contact.

If initial identifications are correct, then the species is similar to *A. textilis*, which would indicate that the vegetation of the Roe Plain was a salt-bush-bluebush association, similar to that of the present day. Neither Victoria Cave nor Henschke's Bone Dig contain avian species useful in paleoenvironmental interpretations.

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HISTORY OF AUSTRALIAN AVIFAUNA (Cont.)

The loss of the family Phoenicopteridae from the Australian continent may correspond to the proposed desiccation within this period. There was a definite reduction in lake levels at this time, which may have removed the habitat necessary to sustain flamingoes.

The period from 20,000 to 30,000 years BP is marked by the last deposit containing dromornithids. Material thought to be *Genyornis* (Fig.4) is associated with radiocarbon dates from Lancefield of about 26,000 years BP. *Gallinula mortierii* (a native hen) was widespread and is present in deposits from King Creek, Queensland to Lancefield, Victoria. Taken as a whole, the avian material from localities of this time period demonstrates little difference from those occurring in the same areas today.

During the height of the glaciation a number of taxa became represented in localities that up to this point had remained more or less similar to current environmental regimes. For example, in Western Australia a species of *Psephotus* is for the first time represented, and if correctly identified as the single extant western species of *Psephotus*, *P. varius* (the mulga parrot), then it indicates a relatively more open forest cover for the southwest coast of Western Australia than at present. In the east, Clogg's Cave at this time contains its first and last appearance of *Pedionomus* (plain wanderers) a genus presently restricted to grasslands, and *Halcyon pyrrhopygia* (the red-backed kingfisher)the species of *Halcyon* now restricted to the dry areas of the Great Dividing Range. Their presence indicates a relatively open woodland with an extensive grassy understory. During this period, *Gallinula mortierii* is last recorded from continental Australia, an event considered to have occurred "as a result of the deterioration of habitat during the last period of intense aridity".

The Holocene in Australia seems marked by the return of many species to ranges held prior to the glaciation and the contraction of the ranges of arid-adapted forms. An exception may have been *Calyptorhynchus lathami* (the glossy black cockatoo) whose range seems to have contracted due to the rise in sea level and the subsequent arrival of Europeans. The faunas from Mabel Cave and Skull Cave both demonstrate the return of many species that were unrepresented during the height of the glaciation.

One deposit that may elucidate both biogeographic and paleoenvironmental information in the future is Colliver's Cave. This

locality has yielded both *Dasyornis brachypterus* (the eastern bristle bird) and *Ptilonorhynchus violaceus* (satin bower bird). Both species are now restricted to areas further east and indicate a period of higher rainfall. Unfortunately, it is still not certain whether this represents a preglacial or postglacial event.

Little, as yet, can be said about the phyletic changes in Australian avian taxa during the Quaternary. What we do know is that some of the taxa now native or endemic to the Australasian region were more diverse and widespread in Australia in the past 40,000 years than they are today, including *Pelecanus*, *Centropus*,

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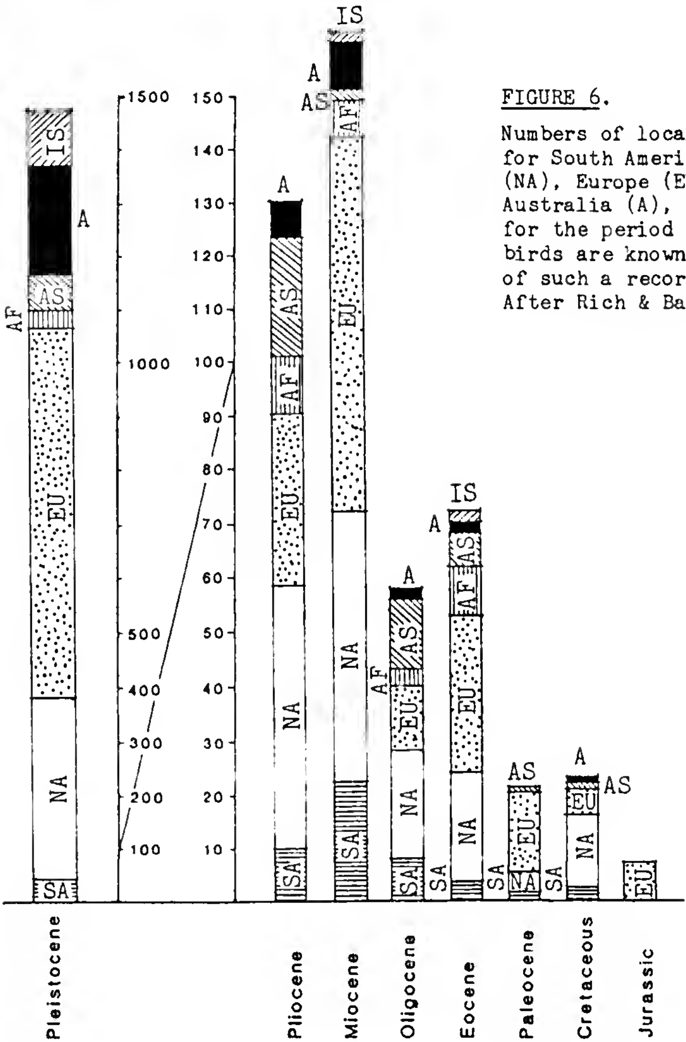

FIGURE 6.

Numbers of localities containing birds for South America (SA), North America (NA), Europe (EU), Africa (AF), Asia (AS), Australia (A), and various islands (IS) for the period of time through which birds are known, exemplifying the bias of such a record.
After Rich & Baird (1986).

HISTORY OF AUSTRALIAN AVIFAUNA (Cont.)

Atrichornis, and *Orthonyx*, and that a number of forms became extinct within that period of time, including *Genyornis*, *Progura*, and a number of species of Phoenicopteridae (flamingoes).

Summary

The record of fossil birds in Australia is poor in comparison to that of several other parts of the world (e.g., North America and Europe; Fig.6), but it offers insights into past environmental conditions and biogeography. It has potential for offering phyletic information, but at present is yet too incomplete to give more than a broad overview for such groups as dromornithids (extinct mihirungs) and aegothelids (owlet nightjars).

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EDMUND CHARLES HOBSON, M.D. — AN EARLY MELBOURNE PALAEONTOLOGIST by N.W. Archbold.

Dr. Hobson was the first native born (in Parramatta, N.S.W.), Australian to systematically study vertebrate fossils from Australia. Born in 1814, he died in 1848 at the young age of 34. Hobson had studied under Sir Richard Owen in London and subsequently established a medical practice in Hobart, 1838. For reasons of health, he moved to the Port Phillip district in 1840 (Gunn,1848a). His early death ended a highly active mind that had investigated animal and human physiology, geology and vertebrate palaeontology (see reference list of Hobson's papers).

Hobson was a founding member of the "Tasmanian Society for the Advancement of Natural Science" (or "The Tasmanian Society" as it came to be known), which was founded in 1839 and flourished under the leadership of Sir John Franklin (Plomley,1969). This society published the "Tasmanian Journal of Natural Science, Agriculture, Statistics &c", the journal to which Hobson submitted his papers and letters.

The "Tasmanian Journal" was published from 1841 to 1849.

Hobson's last paper (published posthumously), was one on a vertebrate fossil - a *Diprotodon* jaw.

Hobson's wife (nee Adamson) was also a keen naturalist and was to provide accurate 'sketch' illustrations of the vertebrate remains illustrated in Hobson (1845c and 1848b). Her sketches were used by the accomplished lithographer, Thomas Ham, to produce the final plates (Thomas Ham was the designer and lithographer of Victoria's first postage stamps produced in 1850). Hobson's wife also discovered the first trilobite recorded from rocks (Silurian) of the Melbourne district. It was identified by Gunn (1848b) as probably *Asaphus*. At that time and for a considerable time after she was the only woman recorded to have had any association with the field of palaeontology in this country.

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BOOKS AND BOOK REVIEWS

GEOLOGY AND MINERAL RESOURCES OF TASMANIA

Special publication of the Geological Society of Australia Inc.,No.15 (1988), edited by C.F. Burrett and E.L. Martin.

This is a major publication of the geology, including geochemistry, geomorphology and geophysics of the State of Tasmania and the surrounding sea floor.

Accompanying this 574 page volume are four maps; a Geological Map; Mineral Deposits and Metallogenic Map; Gravity Map; and Total Magnetic Intensity Contours.

It is available from the Geological Society of Australia Inc., 1001, Challis House, 10 Martin Place, Sydney, N.S.W.,2000, for $85.00.

A REVISION OF THE TERTIARY VOLUTIDAE (MOLLUSCA: GASTROPODA) OF SOUTH EASTERN AUSTRALIA by T.A. Darragh.

This comprehensive revision of the carnivorous burrowing gastropods belonging to the family Volutidae includes the description of twenty two new species ranging from the Late Eocene to Early Pleistocene.

The 330 photographs in 30 plates are of a very high standard and include illustrations of specimens from well known localities such as Fossil Beach, Mornington (VIC.); Muddy Creek, Hamilton (VIC.); Table Cape, Wynyard (TAS.); Bird Rock, Torquay (VIC.) and Hampton Microwave Repeater Tower, Madura (W.A.).

The paper is part of the Memoirs of the Museum of Victoria, Volume 49, No.2, which was released on the 6th February,1989 (Note: Memoir is dated 30th November,1988) and can be obtained from the Natural History Division, Museum of Victoria, 285 Russell Street, Melbourne, Victoria,3000 for $20.00 (postage extra).

THE ELEMENTS OF PALAEONTOLOGY by Rhona M. Black.

Published by Cambridge University Press, 1989.

The new (second) edition of this very popular work combines the beginners approach of the first edition with a depth and breadth of coverage ideal for those wishing to delve further into the realm of palaeontology. New features include trace fossils, microfossils, pollens and electron micrograph illustrations.

According to the Times Educational Supplement "it is suitable for school and university students alike - is truly introductory with many technical terms employed by palaeontologists defined and is well-written and clearly expressed".

You will probably have to order this through your local bookshop,

if so, we recommend you check the cost before placing a firm order.

Both hard cover and paper back versions have been published.

As an idea of cost, reprints of the first edition are still available in Melbourne at a cost of $43.00. United Kingdom prices quoted in New Scientist are £27.50 net (Hc.) and £12.95 net (Pb.).

AUSTRALIA'S FOSSIL PLANTS by Mary E. White
published by Reed Books Pty.,Ltd., Frenchs Forest,N.S.W.,1988.

"Australia's Fossil Plants" is a convenient quick reference handbook for students, fossil collectors and everyone interested in fossils and the prehistoric world.

In addition to illustrating a select sample of fossil plants it provides basic information on the environment in which they lived. It also suggests some of the important but less obvious things to look for when collecting plant fossils in the field.

As with Mary White's comprehensive account of the 400 million year evolution of the Australian continent and its vegetation, "The Greening of Gondwana", this book is illustrated with photographs by Jim Frazier.
Recommended retail price is $14.95.

IN THE NEWS

EARLIEST VERTEBRATE, 470 MILLION YEARS OLD.

Scientists have found the fossilized remains of the oldest and most complete vertebrate yet known: a jawless fish that swam near the shores of a sea some 470 million years ago.

Gabriela Rodrigo de Walker of Bolivia's National Museum of Natural History first found mysterious fossils on the site at Sacabamba in the Rio Challaqui in 1985. Based on her discovery, a French team led by Pierre-Yves Gagnier went to the area the next year and found several more specimens. When they returned in 1987, with the support of the National Geographic Society, they collected the best preserved and most complete specimens of early vertebrates, animals with backbones, ever found. Scientists now have almost 30 complete skeletons of the ancient fish, which averages more than a foot long.

Gagnier, who describes the discovery in the spring issue of National Geographic Research, says scientists had already found bone-like fragments dating from between 470 and 500 million years ago, but none were definitely identified as coming from vertebrates.

National Geographic Magazine: Geographica, March, 1989.